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THE PRACTITIONER'S TOOL KIT

Field pH Monitoring 101

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Editor's Note: The National Environmental Health Association (NEHA) strives to provide relevant and useful information for environmental health practitioners. In a recent membership survey, we heard your request for information in the *Journal* that is more applicable to your daily work. We listened and are pleased to feature this column from a cadre of environmental health luminaries with over 300 years of combined experience in the environmental health field. This group will share their tricks of the trade to help you create a tool kit of resources for your daily work.

The conclusions of this column are those of the authors and do not necessarily represent the official position of NEHA, nor does it imply endorsement of any products, services, or resources mentioned.

It has been 20 years since pH and water activity (a_w) were introduced into the 2005 version of the Food and Drug Administration (FDA) *Food Code*. It broadened the definition of potentially hazardous food (PHF), now known as time/temperature control for safety (TCS) and included two pH and a_w interaction tables in Chapter 1. Then, as now, tables in the 2022 *Food Code* show interaction between pH and a_w in control of spores in heat-treated packaged foods, and control of vegetative cells and spores in food not heat-treated or heat-treated but not packaged foods. After the introduction, it was hoped that this addition would be embraced to meet inspection goals. Those of us who work with institutional, catering, and small artisan production kitchens welcomed the addition of pH and a_w as a way to expand food safety where time, temperature, and hot/cold holding facilities were at a premium and where unique cooking methods require additional monitoring.

The first reaction to our welcome came from FDA, whose spokesperson stated quite emphatically that this information was simply meant as a guideline. With the emerging popularity of ethnic foods, new ingredients, and the introduction of some 33 different cooking techniques and processes, monitoring pH and a_w has taken on new significance, and TCS has taken on a broadened and updated interpretation.

In a previous issue, we published a column about water activity (Balsamo et al., 2025). We will now try to tackle the other half of the TCS definition and hopefully give pH a greater role in our food inspection processes.

We must admit that until recently, there was a lack of information about our inspection application of pH and the use of field measuring tools for food. You will be amazed, however, at the information now available through a simple online search. University-based extension services (e.g., the University of Wisconsin, University of Georgia, Oklahoma State University), FDA, and manufacturers of pH color indicator and instrumentation devices provide exceptionally well-written information on all aspects of pH measurement. We are now comfortable and confident in their use, particularly since many measurement devices are made specifically for food analysis. The selection of simple screening methods, including inexpensive litmus papers and solutions that rely on color change, has been greatly expanded. Field instruments like pH pens and portable meters are now specialized, user-friendly, and adaptable.

We admit that proficiency in conducting field measurements and the ability to feel comfortable when monitoring and interpreting findings during an inspection requires practice through trial and error. Here is our best advice for pH.

As a start, familiarize yourself with pH values of common foods and ingredients (see Sidebar). This knowledge shows us where and how to look.

We begin assaying foods using prescreening tools. For liquids and slurries, wide-range (1–14) pH test papers have numerous uses. The best test papers for food application are ones that measure pH between 3 and 5. If the food being tested obscures the color reaction after immersion, simply rinse the test paper with distilled or deionized water. For solid foods such as sushi rice, we prefer a liquid pH indicator that is applied directly on food that is placed in an easily cleanable and inert white porcelain well. The indicator responds to food pH and color change is visible on the porcelain well. Most often, color indication is apparent, particularly when testing for a pH value ≤4.6.

When the screening result is questionable, greater accuracy is required. To do achieve this accuracy, we rely on pH pens and portable pH meters made specifically for food. Both pens and portable meters require calibration and care that is no more difficult or complex than validating thermometers, which we will cover in a little more detail later in this column.

Whether prescreening or requiring a precise reading, always measure "equilibrium" pH. Equilibrium pH is the pH of a food prod-

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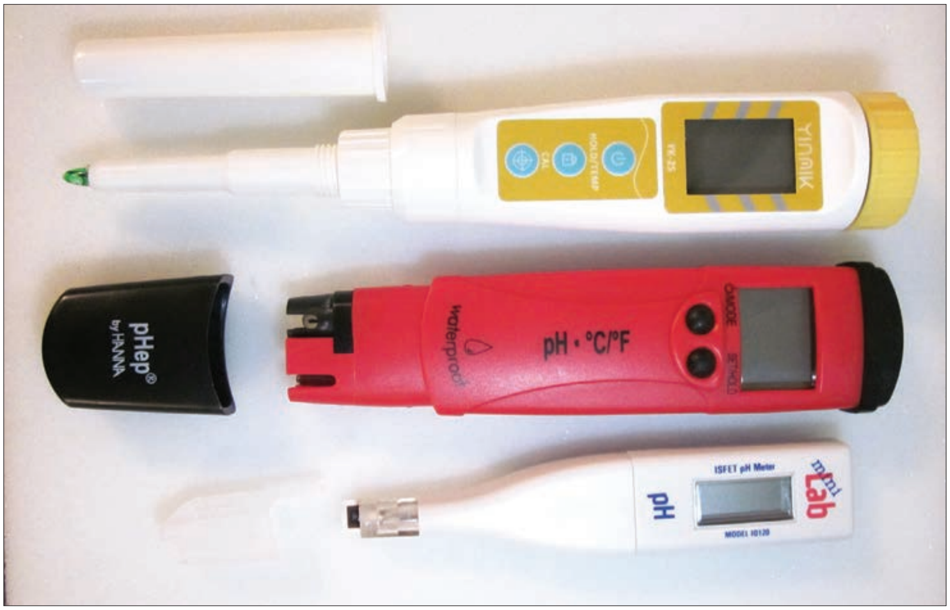

Different examples of portable pH instrumentation, including a high-accuracy single electrode (top), a double electrode (middle), and a single electrode pen (bottom). Photo courtesy of Dr. Robert Powitz.

An example of pH indicator papers (1–14), along with pH indicator fluid, porcelain wells, and a color comparator. Photo courtesy of Dr. Robert Powitz.

List of pH Resources for Foods

- Approximate pH of Foods and Food Products: https://webpal.org/SAFE/aaarecovery/2_food_storage/Processing/lacf-phs.htm
- The pH of Food List from Preserve & Pickle: https://preserveandpickle.com/ph-of-foods-list
- pH of Selected Foods from the U.S. Department of Agriculture: https://pmp.errc.ars.usda.gov/phOfSelectedFoods.aspx
- pH Food Chart from VitaFountain: https://www.vitafountain.com/ph-food-chart

uct after ingredients, including added acid, is thoroughly stirred and is homogeneous throughout the food matrix. Equilibrium is also dependent on temperature and time to obtain a stable value. Let the sample reach room temperature before taking the measurement; changes in temperature cause pH values to drift.

There are three basic rules for selecting samples and four criteria when selecting a portable pH meter.

Sample selection:

1. Foods that are uniformly smooth in texture, such as juices and sauces, can be measured directly.
2. Foods where liquid and solids are distinct and separate, such as pickles and brine, measure the liquid.
3. Solid foods require some preparation if using a pH pen or meter. Blend, crush, or cut the food and add a small amount of distilled or deionized water to produce a slurry. The sample can then be assayed.

Meter selection:

1. Accuracy: The best choice is a meter with an accuracy of ±0.02 units. Meters with an accuracy of ±0.10 are not as useful.
2. Function: The pH electrode should have a nonclogging tip if it is immersed in food. We find spear probes to be the most versatile and easiest to use in the field.
3. Calibration: All pH meters must be calibrated to ensure accuracy. The best meters require a 2-point calibration using pH 4.0 and 7.0 buffer solutions. On occasion, when we have to assess alkaline foods, we make up a fresh pH 10.0 buffer solution from a premeasured packet (alkaline buffer is not stable over time). To ensure accuracy, pH meters should be calibrated at the same temperature as the samples being tested. As

always, make a record of the calibration, including date, time, and results.

4. Compensation: You need to look for a meter that will compensate for slight variations in sample temperatures. This practical feature saves time when you use the meter during an inspection.

Cleaning a pH meter is straightforward. After use, simply rinse the electrode with distilled water (grocery store variety is good). If the electrode probe was used in samples containing fats, proteins, or precipitates, soak the probe in a bit of surfactant or rubbing alcohol. After cleaning, allow the electrodes to regenerate in either distilled or deionized water or a buffer solution.

When storing pH meters, probes should always be kept in a 1–3 M potassium chloride (KCl) solution. These storage solutions are commercially available. The alternative is to simply use older buffer solutions that have outlived their usefulness. If needed, we also make our own storage solution with 1 L of distilled water in which 75–223 g of KCl is dissolved, which makes anywhere from a 1–3 M solution. KCl is readily available as a salt substitute. Also, you can add either potassium or sodium benzoate (a common food preservative) to the storage solution. Follow directions on the benzoate container label for the quantity necessary per volume.

As with your electronic thermometers, store and transport pH papers, pH indicator fluid, and electronic pH meters at as close to room temperature as possible or practical. While traveling, it is best to keep all equipment in a thermal carrier to avoid temperature extremes that might cause damage.

Finally, battery end-of-life is not as obvious in a pH pen or meter as it is in our thermistors, thermocouples, and infrared thermometers. Some meters have a flashing display when the battery charge is low. Most do not, however, give warnings. As battery power wanes, readings can lose accuracy. Our recommendation is to change batteries at regular intervals, regardless of the instrument's age or extent of use.

So, there you have it—field pH monitoring 101. We hope this information will help you embrace the pH of the pH/a_w in your inspections. It can only help to improve your skill as an environmental health professional, but more importantly, it will improve food safety.

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Reference

Balsamo, J.J., Jr., Pees Coleman, N., Collins, B., Noonan, G.P., Powitz, R.W., Radke, V.J., & Treser, C.D. (2025). Complexities and strategies for controlling contamination. *Journal of Environmental Health*, *87*(6), 32–33. https://doi.org/10.70387/001c.129540

